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Shaver Lake
Fresno Lake
California

(U.S.) National Eutrophication Survey, Corvallis, OR

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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REPORT
ON
SHAVER LAKE
FRESNO COUNTY
CALIFORNIA
EPA REGION IX
WORKING PAPER No. 758

WITH THE COOPERATION OF THE
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
AND THE
CALIFORNIA NATIONAL GUARD
JUNE, 1978

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentration (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the California State Water Resources Control Board and the nine Regional Water Quality Control Boards for professional involvement, to the California National Guard for conducting the tributary sampling phase of the Survey, and to those California wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Division of Planning and Research of the State Water Resources Control Board provided invaluable lake documentation and counsel during the Survey, coordinated the reviews of the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

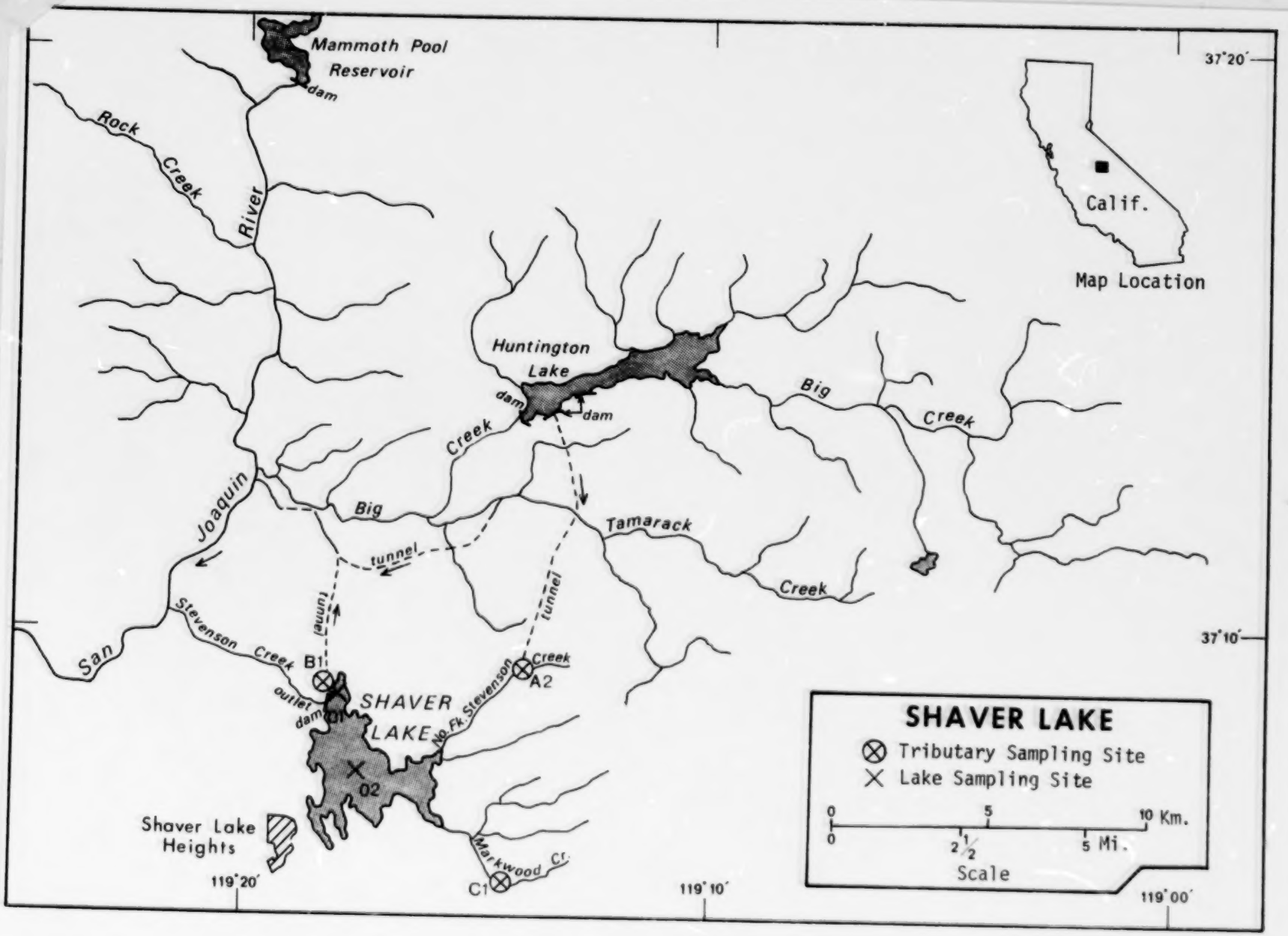
Major General Glen C. Ames, the Adjutant General of California, and Project Officer Second Lieutenant Terry L. Barrie, who directed the volunteer efforts of the California National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of California

Name	County
Amador	Amador
Boca	Nevada
Britton	Shasta
Casitas	Ventura
Crowley	Mono
Don Pedro	Tuolumne
Elsinore	Riverside
Fallen Leaf	El Dorado
Hennessey	Napa
Henshaw	San Diego
Iron Gate	Siskiyou
Lopez	San Luis Obispo
Mary	Mono
Mendocino	Mendocino
Nicasio	Marin
Lower Otay	San Diego
Pillsbury	Lake
Santa Margarita	San Luis Obispo
Shasta	Shasta
Shaver	Fresno
Silver	Mono
Tahoe	El Dorado, Placer, CA; Carson City, Douglas, Washoe, NV
Tulloch	Calaveras, Tuolumne
Lower Twin	Mono
Upper Twin	Mono


Mammoth Pool Reservoir
dam
Rock Creek
River
37°20'
Calif.
Map Location
Huntington Lake
dam
dam
Big Creek
Big Creek
Joaquin
Big
Tamarack
Creek
tunnel
tunnel
tunnel
San
Stevenson Creek
B1
outlet dam
SHAVER LAKE
No. Fk. Stevenson Creek
A2
O1
O2
Shaver Lake Heights
Markwood Cr.
C1
37°10'
119°20'
119°10'
119°00'
SHAVER LAKE
Tributary Sampling Site
Lake Sampling Site
0
5
10 Km.
0
2 1/2
5 Mi.
Scale

SHAVER LAKE

STORET NO. 0622

I. CONCLUSIONS

A. Trophic Condition*:

Survey data indicate Shaver Lake is early mesotrophic. It ranked seventh in overall trophic quality when the 24 California lakes and reservoirs sampled in 1975 were compared using a combination of six lake parameters**. Five of the water bodies had less and one had the same median total phosphorus, four had less and two had the same median dissolved orthophosphorus, nine had less and five had the same median inorganic nitrogen, one had less and one had the same mean chlorophyll a, and four had greater mean Secchi disc transparency. No significant depression of dissolved oxygen occurred at depths as great as 29 meters.

Survey limnologists observed a few emergent macrophytes in early June.

B. Rate-Limiting Nutrient:

The algal assay results indicate the reservoir was phosphorus limited in early June. The reservoir data indicate phosphorus limitation in early and late June but nitrogen limitation in November.

C. Nutrient Controllability:

1. Point sources--No known wastewater treatment plants impacted Shaver Lake during the sampling year. Septic tanks

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* Trophic assessment is based on the levels of nutrients, dissolved oxygen, and chlorophyll a; phytoplankton kinds and numbers; and transparency (Allum et al., 1977).

** See Appendix A.

serving shoreline dwellings were estimated to have contributed 0.2% of the total phosphorus load to the reservoir, but a shoreline survey is needed to determine the significance of those sources.

2. Non-point sources--Non-point sources contributed essentially all of the phosphorus loading to the reservoir during the sampling year. The North Fork of Stevenson Creek, with flow greatly augmented by diversion from Huntington Lake, contributed 85.2% of the total loading. The ungaged minor tributaries and immediate drainage contributed an estimated 12.2%.

The estimated phosphorus loading of 0.71 $g/m^2/yr$ is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading but more than his suggested oligotrophic loading (see page 11). While it does not appear that the present loading can be reduced significantly, every effort should be made to prevent any increase in the loading to protect the existing quality of the reservoir.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 8.39 kilometers^2.
2. Mean depth: 19.9 meters.
3. Maximum depth: 54.9 meters.
4. Volume: 166.870 x 10^6 m^3.
5. Mean hydraulic retention time: 252 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
N. Fk. Stevenson Creek	3.9	6.440
Minor tributaries & immediate drainage -	63.1	1.209
Totals	67.0	7.649

2. Outlet -

Aqueduct	75.4**	7.649**

C. Precipitation***:

1. Year of sampling: 19.3 centimeters.
2. Mean annual: 26.0 centimeters.

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† Table of metric conversions--Appendix B.
†† Dendy, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Shaver Lake was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at two stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 30.5 meters at station 1 and 29.0 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SHAVER
STORET CODE 0622

PARAMETER	1ST SAMPLING (6/ 4/75) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (6/24/75) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/13/75) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	4.6 - 18.5	9.9	7.8	7.5 - 15.7	12.3	12.9	13.3 - 14.4	13.5	13.5
DISS OXY (MG/L)	8.6 - 10.4	9.5	9.6	7.8 - 9.6	8.5	8.4	7.6 - 8.2	7.8	7.8
CNDCTVY (MCROMO)	10. - 16.	13.	12.	14. - 64.	28.	25.	37. - 39.	38.	37.
PH (STAND UNITS)	8.2 - 10.9	9.5	9.5	5.7 - 8.2	6.7	6.4	6.8 - 7.0	6.9	6.9
TOT ALK (MG/L)	10. - 25.	17.	19.	10. - 13.	12.	12.	10. - 26.	16.	16.
TOT P (MG/L)	0.012 - 0.041	0.019	0.015	0.012 - 0.222	0.049	0.014	0.009 - 0.018	0.011	0.010
ORTHO P (MG/L)	0.003 - 0.022	0.007	0.004	0.002 - 0.010	0.004	0.003	0.002 - 0.018	0.004	0.002
NO2+NO3 (MG/L)	0.030 - 0.210	0.061	0.050	0.020 - 0.020	0.020	0.020	0.020 - 0.050	0.026	0.020
AMMONIA (MG/L)	0.020 - 0.060	0.045	0.040	0.020 - 0.070	0.035	0.030	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.200 - 0.800	0.277	0.200	0.200 - 0.500	0.327	0.300	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.050 - 0.250	0.105	0.100	0.040 - 0.090	0.055	0.050	0.040 - 0.070	0.046	0.040
TOTAL N (MG/L)	0.230 - 0.850	0.338	0.260	0.220 - 0.520	0.347	0.320	0.220 - 0.250	0.226	0.220
CHLRPYL A (UG/L)	1.4 - 1.8	1.6	1.6	1.2 - 1.5	1.3	1.3	2.0 - 2.3	2.1	2.1
SECCHI (METERS)	2.7 - 3.8	3.3	3.3	3.0 - 3.0	3.0	3.0	4.7 - 5.2	5.0	5.0

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/04/75	1. Synedra sp.	27
	2. Peridinium sp.	20
	3. Asterionella sp.	20
	4. Ankistrodesmus sp.	7
	Total	74
06/24/75	1. Chroomonas (?) sp.	193
	2. Mallomonas sp.	97
	3. Cryptomonas sp.	32
	4. Dinobryon sp.	32
	5. Synedra sp.	32
	Total	386
11/13/75	1. Cryptomonas sp.	153
	2. Ankistrodesmus sp.	44
	3. Achnanthes sp.	22
	Total	219

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/04/75	1	1.8
	2	1.4
06/24/75	1	1.2
	2	1.5
11/13/75	1	2.0
	2	2.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.035	1.0
0.050 P	0.065	0.035	5.3
0.050 P + 1.0 N	0.065	1.035	22.6
1.0 N	0.015	1.035	0.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Shaver Lake was moderately high at the time the sample was collected (06/04/75). Also, the significant increase in yield with the addition of phosphorus alone indicates that the reservoir was limited by phosphorus at that time.

The reservoir data indicate phosphorus limitation in early and late June but nitrogen limitation in November (the mean inorganic nitrogen/orthophosphorus ratios were 15/1, 14/1, and 12/1, respectively).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the California National Guard collected monthly near-surface grab samples when possible from each of the tributary sites indicated on the map (page v). Sampling was begun in September, 1974, and was completed in June, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the California District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for the North Fork Stevenson Creek were calculated using mean annual concentrations and mean annual flows. It was not possible to directly sample the aqueduct, so outlet nutrient loads were estimated using the mean nutrient concentrations at reservoir sampling station 1 and the mean annual outflow.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Markwood Creek at station C-1 and the mean annual ZZ flow.

No known wastewater treatment plants impacted Shaver Lake during the sampling year.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
N. Fk. Stevenson Creek	5,075	85.2
b. Minor tributaries & immediate drainage (non-point load) -	725	12.2
c. Known municipal STP's - None	-	-
d. Septic tanks* -	10	0.2
e. Known industrial - None	- -	-
f. Direct precipitation** -	145	2.4
Total	5,955	100.0

2. Outputs -

Reservoir outlet - Aqueduct 3,620

3. Net annual P accumulation - 2,335 kg.

* Estimate based on 31 shoreline dwellings and one camp; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
N. Fk. Stevenson Creek	317,840	89.5
b. Minor tributaries & immediate drainage (non-point load) -	28,235	7.9
c. Known municipal STP's - None	-	-
d. Septic tanks* -	400	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	9,060	2.5
Total	355,535	100.0

2. Outputs -

Reservoir outlet - Aqueduct 66,825

3. Net annual N accumulation - 280,710 kg.

D. Mean Nutrient Concentrations in Ungaged Stream:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Markwood Creek	0.019	0.740

* Estimate based on 31 shoreline dwellings and one camp; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.71	0.28	42.4	33.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Shaver Lake:	
"Dangerous" (eutrophic loading)	1.02
"Permissible" (oligotrophic loading)	0.51

V. LITERATURE REVIEWED

Allum, M.O., R.E. Glessner, and J.H. Gakstatter, 1977. An evaluation of the National Eutrophication Survey data. Working Paper No. 900, Corvallis Env. Res. Lab., Corvallis, OR.

Dendy, William B., 1974. Personal communication (waterbody information and morphometry). CA Water Res. Contr. Bd., Sacramento.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0601	AMADOR RESERVOIR	0.040	0.390	408.667	22.383	14.600	0.020
0602	BOCA LAKE	0.012	0.040	372.833	1.700	6.800	0.003
0603	LAKE BRITTON	0.067	0.115	448.500	4.811	11.200	0.047
0604	CASITAS RESERVOIR	0.029	0.050	400.250	3.192	14.000	0.014
0605	CROWLEY LAKE	0.046	0.045	374.750	5.800	12.200	0.034
0606	DON PEDRO RESERVOIR	0.013	0.060	381.733	3.564	11.400	0.004
0607	LAKE ELSINORE	0.469	0.120	489.214	70.572	8.000	0.092
0608	FALLEN LEAF RESERVOIR	0.007	0.040	24.357	0.786	8.800	0.005
0609	LAKE HENNESSEY	0.027	0.060	416.000	4.525	15.000	0.012
0610	LAKE HENSHAW	0.138	0.070	461.000	26.783	9.800	0.073
0611	IRON GATE RESERVOIR	0.184	0.690	440.333	6.217	13.800	0.124
0614	LOPEZ LAKE	0.371	0.090	372.000	8.658	15.000	0.343
0615	LAKE MARY	0.010	0.040	296.000	2.550	10.600	0.002
0616	LAKE MENDOCINO	0.020	0.050	436.500	3.100	9.400	0.008
0617	NICASIO RESERVOIR	0.055	0.345	482.778	6.633	9.800	0.013
0618	LOWER OTAY RESERVOIR	0.058	0.180	447.250	15.933	15.000	0.013
0619	LAKE PILLSBURY	0.022	0.060	466.667	6.389	8.200	0.008
0620	SANTA MARGARITA LAKE	0.037	0.070	400.000	9.122	14.800	0.014
0621	SHASTA LAKE	0.021	0.060	381.542	4.087	9.000	0.015
0622	SHAVER	0.014	0.060	346.400	1.700	7.400	0.004
0623	SILVER LAKE	0.012	0.055	356.000	1.800	7.000	0.003
0624	TULLOCK RESERVOIR	0.025	0.060	433.000	13.878	7.400	0.009
0625	UPPER TWIN LAKES	0.015	0.040	300.200	3.340	7.400	0.004
0626	LOWER TWIN LAKES	0.014	0.040	248.000	2.900	11.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
0601	AMADOR RESERVOIR	35 (8)	4 (1)	43 (10)	9 (2)	17 (4)	26 (6)	134
0602	BOCA LAKE	89 (20)	98 (22)	70 (16)	91 (21)	100 (23)	91 (20)	539
0603	LAKE BRITTON	17 (4)	22 (5)	17 (4)	48 (11)	43 (10)	17 (4)	164
0604	CASITAS RESERVOIR	43 (10)	74 (17)	48 (11)	70 (16)	22 (5)	37 (8)	294
0605	CROWLEY LAKE	30 (7)	78 (18)	65 (15)	43 (10)	30 (7)	22 (5)	268
0606	DON PEDRO RESERVOIR	83 (19)	54 (11)	57 (13)	61 (14)	37 (8)	78 (17)	370
0607	LAKE ELSINORE	0 (0)	17 (4)	0 (0)	0 (0)	78 (18)	9 (2)	104
0608	FALLEN LEAF RESERVOIR	100 (23)	87 (19)	100 (23)	100 (23)	70 (16)	70 (16)	527
0609	LAKE HENNESSEY	48 (11)	54 (11)	39 (9)	52 (12)	4 (0)	52 (12)	249
0610	LAKE HENSHAW	13 (3)	33 (7)	13 (3)	4 (1)	54 (12)	13 (3)	130
0611	IRON GATE RESERVOIR	9 (2)	0 (0)	26 (6)	39 (9)	26 (6)	4 (1)	104
0614	LOPEZ LAKE	4 (1)	26 (6)	74 (17)	26 (6)	4 (0)	0 (0)	134
0615	LAKE MARY	96 (22)	87 (19)	91 (21)	83 (19)	48 (11)	100 (23)	505
0616	LAKE MENDOCINO	65 (15)	70 (16)	30 (7)	74 (17)	61 (14)	63 (14)	363
0617	NICASIO RESERVOIR	26 (6)	9 (2)	4 (1)	30 (7)	54 (12)	46 (10)	169
0618	LOWER OTAY RESERVOIR	22 (5)	13 (3)	22 (5)	13 (3)	4 (0)	46 (10)	120
0619	LAKE PILLSBURY	57 (13)	41 (9)	9 (2)	35 (8)	74 (17)	63 (14)	279
0620	SANTA MARGARITA LAKE	39 (9)	33 (7)	52 (12)	22 (5)	13 (3)	37 (8)	196
0621	SHASTA LAKE	61 (14)	54 (11)	61 (14)	57 (13)	65 (15)	30 (7)	328
0622	SHAVER	78 (18)	41 (9)	83 (19)	96 (22)	87 (19)	78 (17)	463
0623	SILVER LAKE	89 (20)	65 (15)	78 (18)	87 (20)	96 (22)	91 (20)	506
0624	TULLOCK RESERVOIR	52 (12)	54 (11)	35 (8)	17 (4)	87 (19)	57 (13)	302
0625	UPPER TWIN LAKES	70 (16)	98 (22)	87 (20)	65 (15)	87 (19)	78 (17)	485
0626	LOWER TWIN LAKES	74 (17)	87 (19)	96 (22)	78 (18)	37 (8)	91 (20)	463

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0602	BOCA LAKE	539
2	0608	FALLEN LEAF RESERVOIR	527
3	0623	SILVER LAKE	506
4	0615	LAKE MARY	505
5	0625	UPPER TWIN LAKES	485
6	0626	LOWER TWIN LAKES	463
7	0622	SHAVER	463
8	0606	DON PEDRO RESERVOIR	370
9	0616	LAKE MENDOCINO	363
10	0621	SHASTA LAKE	328
11	0624	TULLOCK RESERVOIR	302
12	0604	CASITAS RESERVOIR	294
13	0619	LAKE PILLSBURY	279
14	0605	CROWLEY LAKE	268
15	0609	LAKE HENNESSEY	249
16	0620	SANTA MARGARITA LAKE	196
17	0617	NICASIO RESERVOIR	169
18	0603	LAKE BRITTON	164
19	0614	LOPEZ LAKE	134
20	0601	AMADOR RESERVOIR	134
21	0610	LAKE HENSHAW	130
22	0618	LOWER OTAY RESERVOIR	120
23	0607	LAKE ELSINORE	104
24	0611	IRON GATE RESERVOIR	104

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 12/02/76

LAKE CODE 0622 SHAVER LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 75.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0622A2	3.9	2.12	5.92	4.42	4.84	19.71	21.00	8.27	4.67	2.44	1.90	1.64	0.40	6.44
0622B1	75.4	8.33	6.66	10.00	11.66	5.00	13.33	11.66	13.33	1.67	1.67	3.33	5.00	7.65
0622ZZ	75.4	0.335	0.335	0.774	2.322	6.398	3.251	0.645	0.077	0.036	0.044	0.101	0.134	1.209

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 75.4
SUM OF SUB-DRAINAGE AREAS = 79.3
TOTAL FLOW IN = 91.77
TOTAL FLOW OUT = 91.63

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0622A2	11	74	0.062	16	0.065				
	12	74	0.059	7	0.051				
	1	75	0.093						
	2	75	0.116						
	3	75	0.261						
	4	75	3.964	19	0.311				
	5	75	31.998	17	44.457				
	6	75	44.457	8	48.139				
	7	75	5.550						
	8	75	0.127						
	9	75	0.113						
	10	75	0.085						
0622B1	11	74	5.975						
	12	74	5.692						
	1	75	0.082						
	2	75	3.228						
	3	75	4.106						
	4	75	16.764						
	5	75	17.188						
	6	75	17.245						
	7	75	3.568						
	8	75	8.353						
	9	75	6.853						
	10	75	6.541						
0622ZZ	11	74	0.062						
	12	74	0.068						
	1	75	0.130						
	2	75	0.178						
	3	75	0.340						
	4	75	0.510						
	5	75	7.674						
	6	75	7.419						
	7	75	0.651						
	8	75	0.173						
	9	75	0.042						
	10	75	0.059						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

062201
37 08 40.0 119 18 00.0 3
SHAVER
06019 CALIFORNIA

11EPALES 760109 2111202
0100 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/04	20 00	0000	17.5	8.6	108	15	10.20	25	0.060	0.400	0.050	0.022
	20 00	0003	17.5	9.0		15	10.00	19	0.040	0.200K	0.040	0.008
	20 00	0010	9.5	10.4		13	9.60	18	0.040	0.200K	0.040	0.006
	20 00	0016	7.5			12	9.60	19	0.040	0.200K	0.040	0.004
	20 00	0024	6.3			11	9.20	18	0.060	0.200K	0.040	0.004
	20 00	0045	5.0	9.4		11	8.80	21	0.060	0.200	0.060	0.008
	20 00	0100	4.6			12	8.20					
75/06/24	15 59	0000	15.7	7.8		30	5.90	12	0.030	0.300	0.020K	0.002
	15 59	0005	15.7	7.8		15	6.10	13	0.040	0.200K	0.020K	0.003
	15 59	0020	15.5	7.8		15	5.95	13	0.030	0.200K	0.020K	0.004
	15 59	0030	11.6	9.6		17	5.70	10K	0.040	0.200K	0.020K	0.002
	15 59	0060	8.8	9.2		23	6.20	11	0.030	0.200K	0.020K	0.002K
	15 59	0086	7.9	8.2		27	6.20	10	0.030	0.300	0.020	0.010
75/11/13	08 50	0000	14.4	7.6	186	37	6.90	26	0.020K	0.200K	0.020K	0.002K
	08 50	0005	13.5	7.6		37	6.90	22	0.020K	0.200K	0.020K	0.002K
	08 50	0015	13.5	7.6		37	6.90	24	0.020K	0.200K	0.020K	0.002K
	08 50	0032	13.5	7.6		37	6.90	10K	0.020K	0.200K	0.020K	0.002K
	08 50	0065	13.5	7.8		37	7.00	10K	0.020K	0.200K	0.020K	0.002

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/04	20 00	0000	0.037	1.8	
	20 00	0003	0.018		
	20 00	0010	0.017		
	20 00	0016	0.015		
	20 00	0024	0.014		
	20 00	0045	0.015		
75/06/24	15 59	0000	0.018	1.2	
	15 59	0005	0.017		
	15 59	0020	0.013		
	15 59	0030	0.013		
	15 59	0060	0.012		
	15 59	0086	0.222		
75/11/13	08 50	0000	0.009	2.0	
	08 50	0005	0.010		
	08 50	0015	0.010		
	08 50	0032	0.010		
	08 50	0065	0.011		

K VALUE KNOWN TO BE LESS THAN INDICATED

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STORET RETRIEVAL DATE 76/09/24

062202
37 07 30.0 119 17 30.0 3
SHAVER
06019 CALIFORNIA

11EPALES 760109 2111202
0056 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/04	19 30	0000	18.5	8.8	150	16	10.89	23	0.050	0.600	0.050	0.010
	19 30	0003	18.5	9.0		16	9.60	21	0.050	0.200	0.050	0.006
	19 30	0010	9.5	9.8		11	9.60	21	0.040	0.200	0.210	0.004
	19 30	0016	8.0	10.0		12	9.20	10K	0.040	0.200K	0.040	0.003
	19 30	0024	6.5	10.0		10	9.20	10K	0.020	0.200K	0.030	0.003
	19 30	0040	5.4	9.6		10	9.40	10K	0.040	0.200K	0.060	0.004
	19 30	0054	5.0	9.8		11	9.30	10K	0.040	0.200K	0.060	0.004
75/06/24	15 20	0000	14.7	8.4	120	64	8.20					
	15 20	0005	14.7	8.4		45	8.10	13	0.030	0.400	0.020K	0.010
	15 20	0020	14.3	9.0		14	7.50	12	0.070	0.400	0.020K	0.005
	15 20	0030	11.5	9.0		20	6.80	12	0.030	0.500	0.020K	0.004
	15 20	0060	9.5	9.0		29	6.90	10K	0.020	0.400	0.020K	0.003
	15 20	0095	7.5	8.4		30	6.70	11	0.040	0.500	0.020	0.003
75/11/13	09 10	0000	13.5	8.0	204	37	7.00	10	0.020K	0.200K	0.020K	0.002K
	09 10	0005	13.4	8.0		38	6.95	11	0.020K	0.200K	0.020K	0.002K
	09 10	0015	13.4	8.2		39	6.90	20	0.020K	0.200K	0.050	0.018
	09 10	0035	13.3	8.2		39	6.90	17	0.020K	0.200K	0.050	0.005
	09 10	0076	13.3	7.8		37	6.80	14	0.020K	0.200K	0.020K	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/04	19 30	0000	0.041	1.4	
	19 30	0003	0.015		
	19 30	0010	0.019		
	19 30	0016	0.013		
	19 30	0024	0.013		
	19 30	0040	0.019		
	19 30	0054	0.012		
75/06/24	15 20	0000		1.5	
	15 20	0005	0.022		
	15 20	0020	0.014		
	15 20	0030	0.012		
	15 20	0060	0.012		
	15 20	0095	0.182		
75/11/13	09 10	0000	0.009	2.3	
	09 10	0005	0.010		
	09 10	0015	0.015		
	09 10	0035	0.012		
	09 10	0076	0.018		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/09/24

0622A2
37 09 15.0 119 14 30.0 4
N FK STEVENSON CREEK
06 15 HUNTINGTON LK
T/S-AVER LAKE 141192
BNK 200 FT S UNPVD RD .6 M SE HWY 168 JT
11E-ALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	12	15	0.048	1.300	0.035	0.020	0.025
74/12/07	13	10	0.080	0.800	0.015	0.005	0.030
75/04/14	12	30	0.055	1.750	0.045	0.025	0.025
75/05/17	11	20	0.005	1.150	0.015	0.005	
75/06/08	11	15	0.035	2.600	0.055	0.005	0.020

STORET RETRIEVAL DATE 76/09/24

0622C1
37 05 45.0 119 14 00.0 4
MARKWOOD CREEK
06 15 HUNTINGTON LK
T/SHAVER LAKE 141192
SEC RD BRDG 4.3 MI E OF SLVR LK HEIGHTS
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	11 00		0.040	1.000	0.055	0.010	0.010
74/12/07	11 05		0.040	0.400	0.007	0.027	0.027